Large-scale graphene film synthesized by plasma treatment of Cu foil and its electromagnetic shielding property

M. Ishihara[1], T. Yamada[1], Y. Katou[2], M. Ameya[2], M. Horibe[2], T. Nakamura[3], H. Nanjo[3], T. Ebina[3], M. Hasegawa[1]

[1] Nanotube Research Center, National Institute of Advanced Industrial Science and Technology (AIST), Central 5, 1-1-1 Higashi, Tsukuba, Ibaraki, Japan
[2] National Metrology of Japan (NMIJ), AIST, Central 3, 1-1-1 Umezono, Tsukuba, Ibaraki, Japan
[3] Research Center for Compact Chemical System, AIST, 4-2-1 Nigatake, Miyagino-ku, Sendai, Miyagi, Japan
m.ishihara@aist.go.jp

Abstract

Conventional transparent electrodes make use of indium tin oxide (ITO) and are commonly used in touch screens, flat panel displays and solar cells. Nearly 90% of ITO film market is for the touch screen application, which is expected to grow more and more in the future. Graphene is potential candidates for transparent conductive films for electrical and optoelectronic devices and various other applications due to its high electrical conductivity, chemical and physical stability. Graphene has been prepared by several methods, including precipitation on a silicon carbide surface, mechanical exfoliation from graphite, reduction of exfoliated graphene oxide, and growth by thermal chemical vapor deposition (CVD) on catalytic metal surfaces [1]. Bae e*t al*, reported the synthesis of graphene by thermal CVD on a copper substrate at high deposition temperature of 1000 degree C and fabrication of transparent graphene electrodes [2]. We have synthesized high-quality graphene films by microwave plasma treatment of a copper substrate with Joule heating using low concentration carbon source [3]. The copper foil with A4 (211 mm X 297 mm) size was used as substrate. Few-layer graphene was deposited on the copper foil for a few minutes. The transfer of the graphene films to a desired target substrate is enabled by the wet-etching of the underlying copper foil. This is carried out by treating the film with an aqueous $(NH_4)_2S_2O_8$ solution after a support material is covered on the graphene/copper surface, in our case a surface protective sheet. The surface protective sheet is attached to the graphene/copper surface by using a film laminating roller with applying pressure. The result in a free-standing graphene/sheet film that can be handled easily and rinsed with deionized water to remove residual etchant. The graphene/sheet film is placed on the 188-μm thick polyethylene terephthalate (PET) substrate (graphene facing the surface). Finally, the surface protective sheet is removed from a sheet/graphene/PET film. We measured the transmittance and sheet resistance of the graphene/PET by using a haze meter and four probe method, respectively. The transmittance was 96% (except PET substrate) and the sheet resistance was about 500 ohm. The electromagnetic interference (EMI) shielding effectiveness (SE) of the graphene film was measured by using two waveguide-to-coaxial adapters and a vector network analyzer. The SE of the graphene film was more than several decibel.

References

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